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Mao, Y., Yin, Z.

A hierarchical convolutional neural network for mitosis detection in phase-contrast microscopy images

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AFFILIATIONS: Department of Computer Science, Missouri University of Science and Technology, Rolla, United States

ABSTRACT: We propose a Hierarchical Convolution Neural Network (HCNN) for mitosis event detection in time-lapse phase contrast microscopy. Our method contains two stages: first, we extract candidate spatial-temporal patch sequences in the input image sequences which potentially contain mitosis events. Then, we identify if each patch sequence contains mitosis event or not using a hierarchical convolutional neural network. In the experiments, we validate the design of our proposed architecture and evaluate the mitosis event detection performance. Our method achieves 99.1% precision and 97.2% recall in very challenging image sequences of multipolar-shaped C3H10T1/2 mesenchymal stem cells and outperforms other state-of-the-art methods. Furthermore, the proposed method does not depend on hand-crafted feature design or cell tracking. It can be straightforwardly adapted to event detection of other different cell types. © Springer International Publishing AG 2016.

INDEX KEYWORDS: Cell culture; Computer vision; Convolution; Neural networks; Stem cells, Convolution neural network; Convolutional neural network; Mesenchymal stem cell; Mitosis detections; Phase-contrast microscopy; Proposed architectures; Spatial temporals; State-of-the-art methods, Medical imaging

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CORRESPONDENCE ADDRESS: Yin, Z.; Department of Computer Science, Missouri University of Science and Technology United States; email: yinz@mst.edu

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